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STUDIES IN THE SEX-RATIO IN MAN.

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The numerical proportion of the sexes has always been a subject of great interest. The question whether they occur with equal frequency in man bears a close relation to the problem of sex-determination and comparative sex mortality. While the original sex-ratio is conditioned upon sex-determination, mortality may in the course of time change it. It will be shown that sex-ratio is not constant but varies in the different periods of life and under manifold influences. Most of the information at hand in regard to sex-ratio is derived from statistics of new-born and adults, but as regards intra-uterine life as far back as conception, our knowledge on the subject is limited to a few conflicting estimates. One of the purposes of this paper is to elucidate as far as possible this last problem. Inasmuch as the supposition that sex is determined before or at the time of fertilization is generally accepted, one may speak of a sex-ratio of conceptions, which may also be called original, physiological, or primary sex-ratio. That at birth, therefore, should be termed secondary and finally the sex-ratio of adults, tertiary.

TERTIARY SEX-RATIO.

The consideration of sex-ratio in adults will be limited to general remarks. With only a few exceptions European countries have a greater proportion of women than men. According to Rauber ('00) the sex-ratio¹ including all ages, for all Europe, is 97.8; for Asia 104.6; for Africa 103.3; for America 102.2, and for Australasia 114.3. According to Brooks ('87) the Australasian colonies had in 1881 a sex-ratio of 143.72 for the aborigines, and one of 118.64 for the population of foreign descent. However

¹ The most common method in use for representing the average sex-ratio is to determine a number which indicates the proportion of males to every hundred females. Unless otherwise stated, this is the method herein used. The sex-ratio is also frequently called *masculinity*.

imperfect these computations may be, they nevertheless show that Europe, with its excess of females, assumes a unique position. The following statistics, taken from one of Rauber's tables, represent the number of females for every 1,000 males:

Age in Years.	Austria, 1869.	England and Wales, 1871.	France, 1872.	Germany, 1875.
25-30	1,087	1,111	1,017	1,059
30-40	1,074	1,092	991	1,046
40-50	1,080	1,081	996	1,052
50-60	1,033	1,074	1,008	1,081
60-70	1,022	1,128	1,033	1,114
80-90	1,052	1,376	1,359	1,240

With advancing age the excess of females increases. This is still more clearly shown in a table by Prinzing ('05) taken from the census of 1900 in Germany:

Number of females for every 1,000 males:

0-5 years.....	993	40-45 years.....	1,045
5-10 ".....	998	45-50 ".....	1,067
10-15 ".....	995	50-55 ".....	1,121
15-20 ".....	995	55-60 ".....	1,140
20-25 ".....	1,008	60-70 ".....	1,189
25-30 ".....	1,008	70-80 ".....	1,259
30-35 ".....	1,014	80-90 ".....	1,338
35-40 ".....	1,020	90- ".....	1,751

Inasmuch as in Europe sex-ratio at birth favors males, its subsequent decrease must be the result of a greater mortality among the latter, and in some countries, also, of a greater emigration of males. The unequal mortality is shown in a table by Ploss ('87). For every 100 females there occur the following numbers of male deaths:

Sweden.....	104	Spain.....	107
Russia (Europe).....	105	Austria.....	108
Holland.....	105	Switzerland.....	108
Italy.....	106	Germany.....	109
England.....	107	Greece.....	111
France.....	107	Rumania.....	116

The sex-ratio of mortality may differ under various circumstances; for example, between the ages of 25 and 40 years according to Knöpfel ('07) in rural districts it is below, while in the urban population it is above 100.

SECONDARY SEX-RATIO.

The sex-ratio of the living-born is, on a rough average for all European countries, 105-106; but this number may vary markedly even in comprehensive statistics. Manifold explanations for these variations have been offered and these will be considered briefly farther on. In the individual countries small differences in the secondary sex-ratio may exist, as shown in the following examples taken from a table by Ploss:

Russian Poland.....	101	Denmark.....	105
England and Ireland.....	104	European Russia.....	105
France.....	105	Italy.....	106
Germany.....	105	Austria.....	106
Switzerland.....	105	Massachusetts.....	106
Belgium.....	105	Spain.....	107
Holland.....	105	Connecticut.....	110
Sweden.....	105		

Concerning countries outside of Europe there is little information. Newcomb ('04) states that in Japan the excess of males in more than a million births was practically the same as in European countries. According to the same author, it seems probable that among the negroes of the United States there is a slight excess of female births.

As a result of the unequal mortality of the sexes the secondary sex-ratio becomes reversed early in life. Kroon ('17) states that in Holland the sex-ratio of mortality during the first year of life is 119; that is, the mortality among male infants is one fifth again as great as among females. He also states that during the first two months of life this ratio reaches even 139. Analogous numbers for the first year of life are given by Prinzing ('06):

Italy.....	111	England.....	121
Rumania.....	115	Sweden.....	121
France.....	119	Denmark.....	121
Austria.....	119	Norway.....	123
Switzerland.....	120		

Kroon's statistics show that this high sex-ratio of mortality of the first year soon decreases, reaching its minimum—approximately 80—between the fourteenth and fifteenth year. According to Prinzing ('05) the mortality from the ages of 5 to 20 years is greater in females, and indeed in the latter part of this

period it is the result chiefly of tuberculosis, for which disease the common occurrence of anæmic and chlorotic conditions at the time of puberty furnishes an excellent soil. After this age the sex-ratio of mortality increases rapidly and results in the reversion of an excess of males to an excess of females.

PRIMARY SEX-RATIO.

The sex-ratio of conceptions cannot be determined directly; however there is an indirect method of solving the problem of the original sex-ratio by means of computing the mortality of embryos and foetuses. Only in case the sex-ratio of those dying in utero is equal to the secondary sex-ratio, will the primary be equal to the secondary. If male abortions were absolutely the same as female, then the primary sex-ratio would be smaller than the secondary. If the sex-ratio of mortality during pregnancy exceeds the sex-ratio of the livingborn, then the sex-ratio of conceptions will of necessity be greater than the secondary and indeed all the more so as the total mortality becomes relatively greater. It is necessary, therefore, to consider two factors in order to deduce the primary from the secondary sex-ratio. The following schematic representation will illustrate this:

1. How many male abortions and stillbirths occur to every 100 female abortions and stillbirths?

2. How many abortions both male and female, occur to every 100 living born?

100 living born with sex-ratio 105.5 + a stillbirths and abortions with sex-ratio b .

100 + a conceptions with sex-ratio x .

This scheme becomes complicated by differences in sex-ratio of mortality and in the relative rate of mortality in the various periods of pregnancy. The relative number of stillbirths differs to some extent according to the various authors. This is in part explained by the fact that the statistics are taken from various countries. Rauber states that the stillbirths amount to 4 per cent. of the annual 1,800,000 births in Germany. According to Carlberg ('86), the proportion of stillbirths to the total number of births in Livland lies between 2.58 and 2.90 per cent., while the percentage for Western Europe lies between 4 and 4.5 per

cent. According to Prinzing ('07), reports show that from 1891 to 1900 in every hundred births there were the following proportions of stillbirths:

Austria.....	2.9	Holland.....	4.3
Switzerland.....	3.6	Belgium.....	4.5
Italy.....	3.9	France.....	4.6

These figures are somewhat increased when expressed in percentages of livingborn. Computing from Auerbach's ('12) statistics of over 100,000 births in Budapest, the stillbirths amounted to 3.3 per cent. of the livingborn. Bucura ('05) found that among 40,169 births in the Clinic Chrobak in Vienna 5.8 per cent. were stillborn; Le Maire ('06) found 5.7 per cent. among 40,339 births in Copenhagen. Both of these figures are too high, inasmuch as these authors did not use the term *stillborn* in the usual sense, a small number of abortions being included. Bernoulli accepts 4 to 5 per cent. stillbirths to the total number of births.

The relative number of abortions is extremely difficult to determine, inasmuch as everywhere large numbers, especially of the earlier months, remain unknown. Williams ('17) expresses himself on this point as follows: "A conservative estimate would indicate that about every fifth or sixth pregnancy in private practice ends in abortion, and the percentage would be increased considerably were the very early cases taken into account, in which there is profuse loss of blood following the retardation of the menstrual period for a few weeks." Other obstetricians give different estimates. Franz ('98) found 15.4 per cent. of pregnancies ending in abortion, Malins ('03) 19.23 per cent. Taussig ('10) estimates that one abortion occurs to every 2.3 labors, Pearson ('97) to every 2.5 labors. Auerbach reports that according to estimates for Berlin, abortions amount to one-sixth to one-tenth of the number of livingborn. According to the same author, there were in Budapest in 1901-05, 111,139 living born, and in the years from 1903-05, 7,702 abortions. Assuming an approximately equal number of livingborn for each year, the livingborn between 1903 and 1905 would amount to 66,678, of which number there would be 11.55 per cent. abortions. This percentage is doubtless too small;

Auerbach himself assumes that many abortions of the earlier months are concealed. The same author found that of his material 3,635 abortions, or almost half, fell within the first three months of pregnancy, and it is for this very period that the statistics are incomplete; therefore in reality much more than half the number of abortions belong to the first three months. According to Franz 42.6 per cent. and according to Dührssen even 59 per cent. of abortions occur in the third month alone.

The sex-ratio of stillborn is much higher than that of living-born. A table taken from Morgan ('13) gives the following sex-ratios of stillborn for European countries:

Norway.....	124.6	Denmark.....	132.0
Holland.....	127.1	Belgium.....	132.0
Germany.....	128.3	Austria.....	132.1
Hungary.....	130.0	Switzerland.....	135.0
Italy.....	131.1	Sweden.....	135.0

Such high sex-ratios of stillborn as that of Walter (260) or that of Tschuprow (400) are probably based upon relatively limited material and do not represent true ratios.

Auerbach gives detailed information concerning the sex-ratio of abortions. This author's material is distributed among the different months as follows:

7th month.....	402 ♂	348 ♀ sex-ratio.....	116
6th "	506 ♂	437 ♀ " "	116
5th "	645 ♂	396 ♀ " "	163
4th "	928 ♂	405 ♀ " "	229
<hr/>			
4th-7th "	2,481 ♂	1,586 ♀ " "	156.4

For the first three months of pregnancy he assumes that the sex-ratio of abortions is at least equal to that of the fourth month, namely 229. It seems to him more probable, however, that it increases in constant proportion; therefore he estimates 322 for the third month and 452 for the second month. According to Carvallo ('12) the sex-ratio of dead embryos up to the fourth month is 250; this figure he calculated from the statistics of Paris in 1908. Körösy ('98) found the sex-ratio of 3,781 abortions to be 152.4. Pinard and Magnan ('13) report on 1,229 abortions, the age of which is not stated. This material showed a sex-ratio of

only 101.1. Rust ('02) also found the sex-ratio of 454 abortions from the first six months very low, namely 101.8. It is apparent how greatly these figures vary. A new contribution towards the knowledge of sex-ratio of abortions, even if based upon a relatively small amount of material is, therefore, not valueless, especially inasmuch as great care has been taken to determine age and sex. The material for these statistics comprises almost 600 fœtuses from the collection of the embryological department of the Carnegie Institution. Age classification was based upon the sitting height (Keibel and Mall '10). Rauber published the sex of 57 fœtuses with their sitting height; these have been made use of with the author's material. Normal and pathological fœtuses, for the most part white, were used in this study. In a limited number of cases no parental history was available; however, it is very probable that the majority of these also were white. Among the few specimens of races other than white, there is a preponderance of negro. The total material from three to ten months comprises 332 males and 315 females, showing a sex-ratio of 105.4. Rauber's material alone gives a sex-ratio of 159. The sex-ratio of the definitely white fœtuses amounts to 118.7. In the various months it is as follows:

Month.	Total.	White.
3d.....	123.7	108.3
4th.....	110.5	109.4
5th.....	108.1	163.4
6th.....	58.8	76.0

The material upon which are based the sex-ratios from the seventh to the tenth month is too limited to be of much value when represented for each month. The exceptional sex-ratio of the sixth month must be explained as a chance occurrence. The same may be true for the sex-ratio (78.9) of all the pathological fœtuses. According to the latter, female abortions are more frequently pathological, a finding which is difficult to correlate with the greater mortality of male fœtuses. The greatest deviations in the ratios obtained by Auerbach and Carvallo on the one hand, and by the author on the other, occur in the third and fourth months, for which Auerbach found the ratios to be 322 and 229, and Carvallo, 250. The author's corresponding figures are as

low as 124 and 110. The great excess of male abortions in the early months of pregnancy, as found by Auerbach and Carvallo, may find its explanation in the fact that in the statistics used by them the sex of the foetuses was determined by various individuals, who had not the necessary specialized knowledge. Early in the differentiation of the external genitalia only the expert can state the sex with certainty. At this time, and even later, the inexperienced, misled by the size of the clitoris as well as by other factors, may erroneously determine the foetus as male. Fewer errors would be made if only those cases definitely male were reported as such, and all the doubtful cases were designated as female. Even granted that larger statistics might raise the sex-ratio, the latter would never reach the high figures stated by Auerbach and Carvallo and assumed by others. Just as sex-ratio of mortality following birth varies according to age, so is it found to be true for pregnancy. Nothing is known in regard to the sex-ratio during the first two months of pregnancy; however that of the third month might be used hypothetically for this period. The mortality of male foetuses in the third month, which is about one fourth again as large as for females, is followed by a mortality in the fourth to the seventh months which is approximately relatively equal, for both sexes. During the eighth to tenth month this relation again shows a higher mortality for the males. The author's material from the fourth to the seventh month shows a sex-ratio of 101.1. However, on account of the great variability in the individual months, it is quite probable that of the male and female foetuses that survive the third month, the number that perish during the following period up to the seventh month is relatively, not absolutely, equal.

If one proceeds to make use of the above citations and figures in computing the primary sex-ratio, rough and approximately average values must first be established. The following appear to be most probable:

For each 100 living born	with sex ratio	105.5
8th-10th month 4 still born	" " "	130
4th-7th " 9 abortions	" " "	106.3
0 3rd " 14 abortions	" " "	125
<hr/>		
127 conceptions	" " "	x

From this, x or the primary sex-ratio is found to be 108.47. The relative number of conceptions was estimated by Rauber to be 100 to 76 living born or calculated as above 131.6 to 100 living born. This number is somewhat larger than that obtained by the author, namely 127. The sex-ratio of conceptions was estimated by Bernoulli as 108.2. Slightly higher (108.7) is the ratio computed by Jendrassik ('11) from statistics collected by Bodio. Both these figures are strikingly similar to that of the author, namely 108.47. Lenhossék ('03) estimates the primary sex-ratio as 111; Auerbach as 116.4 but the latter believes that it would reach at least 125 if corrections were made.

Even if these approximate averages, which become constant only when based upon extensive material, must be accepted *cum grano salis*, it may nevertheless be stated with certainty that more males (probably not more than 10 per cent.) are conceived, and that at certain periods of pregnancy the relative mortality of males exceeds that of females by as much as one fourth.

DETERMINATION OF AND CHANGES IN THE PRIMARY SEX-RATIO.

Now arises the question as to what determines this unequal distribution of sexes at conception. Its discussion dates back into antiquity, Hippocrates and Galen asserting that males originated from the right testis or the right ovary, females from the left. It has been proved that this theory is untenable; however, the idea of the possibility of two distinct varieties of spermatozoa was again revived in more recent times. Wilson ('05) distinguishes male-producing and female-producing spermatozoa. This might lead to an unequal distribution of sexes at conception. Morgan suggests that it may be due to a difference in the rate of travel of the two types of sperm, or that a disease process, or a factor such as alcoholism, might affect one type to a greater degree than the other. Hertwig ('12) attributes sex-determination to the ovum or the degree of its maturation, an advanced stage of maturation producing males. In this way he attempts to explain the difference in sex-ratio according to social class. Thury ('63) had proposed the idea that ova which are fertilized late may produce more males. Thus he explained the high sex-ratio among Jews, who, on religious grounds refrain from inter-

course for seven days following menstruation. Lorenz ('98), Lenhossék and Orschansky ('03) are of the opinion that sex is subject to hereditary influences, inasmuch as they found families in which males predominated and those in which females appeared in excessive numbers. Newcomb, Woods ('06) and Heron ('06) deny this and show that inheritance plays no part in the sex-ratio. Numerous authors attribute its variations to the absolute and relative ages of the parents. According to Rosenfeld ('00) there is a decided preponderance of male children born to young and old fathers, as compared with those of middle age. Francke, from the statistics of Norway, found this to be true in respect to young fathers, but reached an opposite conclusion as regards old ones. Dumont ('94) found for Paris a sex-ratio of 101.9 when the fathers were from 18 to 25 years; 104.2 when the fathers were between 26 and 50 years and 97.5 when the fathers were over 51 years. According to E. Bidder ('78), the sex-ratio of births by mothers under 18 years and over 40 years is especially high. Sadler ('30) stated that the relative ages of the parents determines the sex-ratio; the latter is 86.5 when the father is younger than the mother, 94.8 when both are of equal age, and reaches 163.2 when the father's age exceeds the mother's by 16 or more years. Kollmann ('90) obtained an opposite result. He therefore draws the conclusion, based upon extensive material, that the sex-ratio is high when the father is younger, and low when he is older than the mother. At the same time he opposes the view that the absolute age of the mother has any influence whatever upon the sex-ratio. Stieda, on the basis of his investigations, reaches the conclusion that any influence of the absolute ages of the parents is out of the question, as he noted the highest sex-ratio when the parents were of equal age. Numerous other authors have occupied themselves with the question of parental age as an influence upon sex-ratio, but only two additional ones will be mentioned, Boudin ('62) and Stadler ('78). The conflicting views which have been presented suffice to show that nothing definite is known concerning a correlation between the age of parents and sex-determination; in fact such a correlation is hardly to be expected. Pearl ('08) in a very careful study demonstrated that there are more males produced when the

parents are of different racial stocks. The well-known assertion that sex-ratio rises after wars, has evoked various attempts at explanation. The following few examples are given: Ploss ('58, '61) ascribes it to malnutrition of the mothers. Berner ('83) believes it to be due to the diminished concurrence which follows wars and which brings about an increased prosperity. Düsing sees the cause in the increased sexual demands upon the male, which also is said to increase the sex-ratio in polygamy. According to Newcomb, following the Civil War no increase in sex-ratio was observed. In the cases where a difference was confirmed it was so slight¹ as not to exceed the normal variations as shown by Lehr ('89), Carlberg and others, and is to be considered as such. Variations of sex-ratio have been determined not only for individual years and for groups of years, but also for the seasons. According to Goehlert ('89) in autumn and winter relatively few conceptions take place, but a higher percentage of these are male.

CHANGES IN THE SECONDARY SEX-RATIO.

The primary sex-ratio, as shown above, becomes transformed by an unequal intrauterine mortality of the two sexes into a different secondary sex-ratio. The greater mortality of males during certain periods of prenatal life is explained by Carvallo as follows: "*les garçons sont plus fragiles.*" Auerbach also considers the male foetus less resistant. Grassl ('12) finds an explanation for the difference in the viability of the germ plasma. Jendrassik speaks of hereditary reduction of vitality among the excess of males. Rauber explains the greater mortality of males by the greater demands of the larger foetuses upon the mother, the latter not always being able to meet them; the production of a female does not require as much from the mother. Lillie ('17) offers the suggestion that the greater mortality among male foetuses is a result of disturbance of the equilibrium that protects the male from the sex-hormones of the mother. It seems probable that this is the case, especially in the first part of pregnancy.

¹ For example Henneberg's ('97) statistics show that in Holstein between 1835 and 1845 the sex-ratio was 105.76, after the period of war from 1846 to 1853 it was 106.67.

The excess of male stillbirths is ascribed by most authors to the more difficult labor attendant upon the greater size of the male, especially the circumference of the head. In regard to this question Dutton ('10) is of the opinion that at the time of birth the bones of the male skull are as a rule more firmly ossified than those of the female. In this connection he states also that with the advance of civilization the pelvic development in women is not proportionate to the cephalic development which is taking place in infants. This perhaps explains the fact shown by Bluhm ('12) that the relative number of induced premature births is on the increase. That labor in cases of male children more often demands artificial aid from the obstetrician is shown by Prinzing, according to whom 6.18 per cent. of male births in Württemberg called for operative measures, as compared with 4.67 per cent. in the births of female children. The process of labor itself is the cause of only a small percentage of stillbirths, the majority dying before labor sets in.¹ Therefore, the greater size of the male cannot in itself be held responsible for the high sex-ratio of stillborn. According to Treichler ('95) 29.6 per cent., and according to Prinzing ('07) 32.6 per cent. of all stillbirths are premature, and in the sex-ratio of these size plays but little part.

Frequently sex-ratio has been studied in relation to the pelvic diameters of the mother. The results are somewhat conflicting. Hoffmann ('87), Dohrn ('88) and Orschansky ('94) may be mentioned, according to whom the sex-ratio in children of mothers with narrow pelvis is small; in contrast to this, Linden ('86) states it to be 133 in 360 births in which the mothers had narrow pelvis. In case the size of the pelvis really has an influence, this can be exerted only upon the secondary sex-ratio in the way of elimination. In the same manner it seems evident that many of the factors which apparently affect the sex-ratio do not change it at conception, that is, they do not have any sex-determining effect, but by their influence upon intrauterine mortality they change only the sex-ratio of births. The well-known fact that the secondary sex-ratio among Jews is relatively high is explained by Düsing on the ground of incest, blood marriages being of

¹ According to Ladame ('04) those dying during labor amounted to 36.4 per cent. of all the stillborn in Switzerland in 1900.

frequent occurrence in that race. Schultze ('03), on the other hand, has demonstrated that inbreeding has no effect upon sex-determination. The relative infrequency of abortions and stillbirths among Jews, as has been shown, for instance, by Auerbach for Budapest, explains very simply the fact that the secondary sex-ratio among Jews is higher and therefore closer to the primary. Punnett ('03) and others have shown that the births among classes of lower social status present a lower sex-ratio than those of the rich. The explanation lies again in the fact that the greater frequency of abortions among women of the working classes who can spare themselves less during pregnancy and in whom pregnancies occur in more rapid succession¹ results in a greater reduction in the sex-ratio, which was originally equal in the two classes. In addition, this greater reduction of the primary sex-ratio in the poorer classes is due to the higher percentage of stillbirths; according to Conrad in Halle among laborers it was 5 per cent., while among upper classes it was only 2.1 per cent.; and according to Verrijn Stuart ('01) in Holland, among the poor 3.16 per cent. and among the rich 2.50 per cent. of all births. A further example illustrating how the primary sex-ratio was erroneously thought to be influenced is shown in its difference between legitimate and illegitimate children. Heape ('09) states that the sex-ratio of legitimate births among the white population of Cuba is 109.0, stillbirths included; that of the illegitimate only 105.95; there is even a greater difference among negroes, the sex-ratio being 97.91 for illegitimate children and 107.73 for legitimate ones. Heape immediately draws the conclusion that illegitimate unions result more often in the conception of females than do legitimate unions. According to Düsing the sex-ratio of legitimate births in Prussia, between the years of 1875 and 1887, was 106.37, that of illegitimate only 105.54; the stillborn in legitimate unions amounted to 3.91 per cent.; in illegitimate 5.32 per cent. A corresponding difference was demonstrated by Bertillon ('96) in the frequency of legitimate and illegitimate abortions. The greater mortality of illegitimate fœtuses reduced the sex-ratio to a greater degree. The rule that the sex-ratio is greater in

¹ According to Düsing ('84) the longer the intervals between births, the greater is the sex-ratio.

legitimate than in illegitimate births is not, however, without exception. Srdinko ('07) found that the sex-ratio of legitimate births in Austria was lower than that of the illegitimate, and explains this by the fact that the illegitimate are for the most part Jewish, in which race abortions are less frequent. According to a number of authors, the sex-ratio of first born is greater than that of subsequent births.¹ It is especially high in older primiparæ, as shown by Ahlfeld ('72 and '76), Janke ('88) and Bidder ('93). Lewis ('06) reports that in Scotland the sex-ratio of first born was 105.4 and that of subsequent births 104.8. That this at least in part is also due to different intrauterine mortality may be supported by the following citations. According to Franz, abortions are more than twice as frequent in multiparæ than in primiparæ. Moreover, the first-born children are appreciably smaller than subsequent ones, as demonstrated by Schaetzel ('93), a condition which would suggest a lower rate of mortality before birth as a result of the relatively fewer demands made upon the mother (Rauber). Hansen ('13) states that in Denmark the first-born weigh on an average 3,457 grams; the second-born 3,607 grams, third-born 3,698 grams, the difference between the first and second being much greater than between the subsequent ones. Stillbirths, however, according to Duncan and Duke ('17) are more frequent among first-born than among second- and third-born, in spite of their smaller size; only in the case of children from the sixth pregnancy does the percentage of still born exceed that of first-born. However, inasmuch as many more abortions than stillbirths occur, comparatively little importance can be attached to this.

Besides the above mentioned causes for the variations found in sex-ratio, many others have been discussed in the literature. Only a few of these factors actually exert any influence upon the sex-ratio of conceptions. The changes have all been found in the secondary sex-ratio and the probability is great that the factors causing them play not a sex-determining but a sex-eliminating rôle. This is true chiefly in regard to changes resulting from locality, such as rural and urban districts, from age, nutri-

¹ A table demonstrating this may be consulted in Newcomb's article.

tion and health¹ of the mother. To what extent race determines the sex-ratio of conceptions cannot as yet be stated; however it is not improbable that differences exist in various races.

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